GRA, Incorporated
Economic Counsel to the Transportation Industry

ENVIRONMENTAL RESEARCH BEYOND 2000
TASK 5 – CONDUCT FINDINGS WORKSHOP AND PREPARE REPORT

Draft Findings Workshop Report

September 30, 1998

Work Order - 42
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Submitted to:

Office of Environment and Energy
Federal Aviation Administration
Washington, DC 20591

For review by Workshop Participants

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Ground Rules/Guidelines for Reviewing/Commenting on the Draft Findings Workshop Report

1. With the exception of corrections of grammatical errors or stylistic suggestions (which are always welcome), reviewers should seek to describe the suggested research avenues more fully, and not seek to excise material in the draft deemed objectionable for whatever reason. In most cases reviewer comments will be added to the existing text as an appendix.

2. Because the Workshop Report needs to reflect what transpired at the Findings Workshop, it is not possible to add new R&D proposals to the list developed at the workshop. If as part of your comments on this draft you would like to propose additional R&D possibilities, they will be passed on to AEE managers, and included in the Final Report within an appendix.

3. Reviewers are asked to comment on the draft's depiction and treatment of the final list of proposed aviation related environmental research possibilities for the Office of Environment and Energy. The Final Workshop Report will also contain additional narrative sections (as shown in the Table of Contents), but these provide background information only, and are not included for review.

4. Please provide your comments in a Word or Word Perfect computer file (or a PDF file if you desire). Unless you instruct otherwise, the fonts and pitch sizes you use may be changed. If you want to simply email comments (within the body of an email message rather than as an attached file), the comments will be cut and pasted into a Word document. If you provide print versions of comments only, they will be scanned into the final electronic version of the document.

5. Comments may be emailed directly to Jim Littleton at the FAA Office of Environment and Energy at james_littleton@faa.gov or to David Ballard of GRA, Inc., the contractor preparing the report, at bdballard@gra-inc.com . Printed comments, or computer diskettes, may be mailed to

Jim Littleton, AEE-120 Office of Environment and Energy Federal Aviation Administration Room 902 800 Independence Avenue, SW Washington, DC 20591	OR	David Ballard GRA, Incorporated 115 West Avenue Suite 201 Jenkintown, PA 19046

6. The deadline for submitting comments on the draft Workshop Report is close of business (5pm ET) Tuesday, October 13, 1998.

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PROCESS ISSUES—ESTABLISHING AND MAINTAINING LINES OF COMMUNICATION BETWEEN AEE AND AVIATION SYSTEM STAKEHOLDERS

Those attending the workshop briefly discussed ways to improve AEE's ability to communicate its activities to persons and organizations with related concerns. Time was allocated to this issue because several participants at the earlier *ER2000* Public Meeting felt that AEE's use of the Federal Register as the sole means of notifying the public was very inadequate and incomplete. The point was made that the meeting occurred at the start of the *ER2000* program, and since then AEE has developed more direct lines of contact with aviation system stakeholders, especially organizations that do not represent segments of the aerospace industry.

There were numerous suggestions about effective means by which AEE could contact and communicate with interested parties outside of FAA, including

- Increase use of the AEE website (http://aee.hq.faa.gov/), especially the AEE-100 Technology Division page (http://www.aee.faa.gov/aee-100/), where online information about *ER2000* is located
- Publicize AEE activities, such as *ER2000*, using press releases distributed to aviation related media and organizations
- Make use of existing databases and mailing lists of interested parties, especially that developed by the Federal Interagency Committee on Aviation Noise (FICAN). Other sources include local and state government offices and associations, and other Federal agency public liaison offices and Congressional offices (members and committees).
- In the case of meetings or events with specific local interest, paper flyers could be distributed to inform affected households and businesses.

Related issues were also discussed (but not definitively resolved), including

- How should the tradeoffs between meeting comprehensiveness and meeting focus be managed in the future, if the number of participants becomes large? It was agreed that the size of the current Workshop was about right for balancing a diversity of concerns and backgrounds with the ability for the group to cover an issue and move on to others. This would be less likely with a larger group. It was suggested that if the population interested in attending a meeting became so large as to reduce the meeting's effectiveness, it may be worthwhile to hold multiple regional meetings.
- In many cases, organizations may profess interest in topics to be addressed by a meeting, but do not actually participate in the meeting. How should such organizations be treated in follow on activities? It was suggested that such groups be informed of the meeting's events and activities, and invited to submit comments as desired.

- How much lead time should exist between the announcement of an event and its occurrence? It was suggested that six months is not too long, since some grass roots national organizations often need time to inform and organize dispersed memberships, although it was also suggested that electronic means of communication (email, etc.) could reduce the time needed.

For this Findings Workshop, draft Workshop Reports will be distributed (electronically or by post) to Workshop participants and other interested parties for review and comment. These comments will be used to complete the final Findings Workshop Report.

PROPOSED AVENUES OF AVIATION RELATED ENVIRONMENTAL R&D

❖ Recommendations by Breakout Groups for Areas of AEE RE&D Focus, Activity, and Funding

While acknowledging the diverse and sometimes opposing viewpoints of the aviation system stakeholders who contributed time and effort to the Findings Workshop, it is important to reemphasize the workshop's purpose, which was to identify beneficial avenues for AEE environmental RE&D. There was not universal agreement on issues and concerns among the workshop participants. In addition, the assessment of potential research issues by aviation system stakeholders, as developed during the Findings Workshop, represents one of several inputs that AEE managers will use in fashioning a proposal for RE&D funding. Not all workshop recommendations will necessarily be carried forward to AEE's RE&D proposal and plan, which may be limited by available funding and by other priorities and obligations.

For these reasons, the emphasis of the Findings Workshop Report is primarily placed on the final lists of beneficial research avenues which were agreed to by workshop participants. Much less emphasis is given to the process by which the participants arrived at these lists, since it is the list of potential projects, and not the specific reasons that one or another participant may have used to propose or oppose a project, that will serve as an input for AEE decisionmakers. In many cases the breakout groups had to convert an issue of concern or contention into a proposal or avenue for focused research.

Workshop participants separated into breakout groups to address three broad but distinct areas for aviation-related environmental research. The remainder of this section presents each breakout group's proposed list of RE&D activities that could be beneficially pursued by AEE. In some cases issues that were discussed within a breakout group were not regarded as appropriate for AEE-directed research activities, but were regarded as important enough to refer to a more appropriate FAA office.

Emissions Breakout Group

The Emissions Breakout Group concentrated on aircraft and other aviation-related emissions. The group was tasked with reviewing the materials from the ER2000 Findings Report and suggesting additional areas of concern for potential research. To this end, the group worked through each issue, to develop recommendations for research projects to better measure the impact of aviation-related emissions on people and the environment or to mitigate the effects of aviation emissions.

Aviation-related Emissions Research Avenues/Areas Identified

Each of the items listed below describes an area for potential research into the environmental impacts of aircraft and aviation-related emissions. Each item represents

an avenue for beneficial future research activity which the Emissions Breakout Group believes should be considered as part of AEE's proposal for RE&D funding for FY2001 and beyond. Following each of the research items are details related to the item's meaning, motivation, and justification.

Develop Necessary Enhancements in the Emission and Dispersion Modeling System (EDMS) Model

- Developments in the capabilities of the EDMS model and software have outpaced the development and acceptance of airport-specific databases
- Emissions from a range of airport users (e.g., ground transportation) and uses (e.g., aircraft taxiing) need to be more accurately modeled
- FAA leadership in worldwide aviation should include an airport emissions model that inspires confidence from all users of the model

Improve Environmental Impact Measurement for Emissions Occurring at Altitudes below 3,000 Feet

- The Emissions Breakout Group used "altitudes below 3,000 feet" as the cutoff for distinguishing local air quality concerns from upper atmospheric concerns—of importance since in some cases approach and departure procedures take the "below 3,000 feet" perimeter beyond the airport's boundaries
- Research in this area may be pursued in partnership with the Environmental Protection Agency (EPA), under Memoranda of Understanding or other interagency agreements

Improve the Consideration Given to Models and Forecasts of Aviation Growth, Airport Utilization, and Technology Improvement in Forecasts of Future Emissions

- Much of this research will involve integrating existing models of aviation growth and fleet changes with models of aviation-related emissions
- In some cases, airports need more integrated models for estimating local emissions impacts in the future, although the legal standing of such models is outside the influence of possible AEE research efforts

Develop Tools to Examine Trade-offs between Aviation-related Noise and Emissions

- The overall environmental impact of technical or procedural improvements must be considered. For example, techniques for noise reduction may increase fuel burn and thereby increase aircraft emissions. A full accounting for environmental effects may require new modeling tools
- A specific project could link or integrate EDMS with the Integrated Noise Model (INM)
- This may be an area well-suited for joint work by FAA and NASA

Identify the Environmental Impact of Airline Service Patterns

- The use of hub and spoke air service networks influences the number of departures and arrivals undertaken by carriers, which will in turn influence the overall level of emissions and other environmental impacts, and methods to gauge these impacts may be valuable

Technical Research on Particulate Emissions and Impacts

- There is a general paucity of research on particulates and their health effects, although the literal visibility of particulates including soot makes them of interest for the public
- Currently the Department of Defense (DOD) is studying particulate emissions from military aircraft engines, and the University of Missouri at Rolla has data on particulate health effects
- Data collection and analysis related to airport and aircraft engine particulates could be jointly pursued by FAA, EPA, and/or NASA

Measure Emissions from Ground Access to Airport

- Such research could provide a basis for measuring the environmental impact of the complete trip taken by an air passenger
- This area of research could be jointly pursued by FAA and other agencies within the Department of Transportation (DOT) concerned with ground transportation modes
- The role of the FAA with respect to individual airport parking facilities and choices is a policy question which this research could inform but not determine

High Altitude Emissions Models

- Due to the nature of the ecosystem, this is, more than any other, a global problem, and it is being addressed by ICAO/CAEP, the Intergovernmental Panel on Climate Change (IPCC), and NASA
- It may be valuable to identify and catalog the various high altitude emissions models being developed. This may include providing new funding for the Global Aviation Emission Forecasting (GAEF) Model, and pursuing joint efforts with NASA
- A need regarded as pressing by some stakeholders is the integration of information on the impacts of emissions at high altitudes with future aircraft certification issues

Develop Regional Emissions Models for Areas with Multiple Airports

- The flexibility to model these situations may become more valuable as more regions (e.g., Chicago, Southern California, Central Texas) begin to receive significant air transport services from multiple airports
- This area of research could be jointly pursued by FAA and EPA

Exploratory Study of the Environmental Impact of Commercial Space Operations

- This research is envisioned as being exploratory at the outset, to determine whether significant emissions-related issues may arise as launch activity increases domestically and internationally in the future, including launches over land as well as over water
- This area of research could be jointly pursued by FAA, NASA, and/or DOD

Develop Emissions Models and Metrics for Intermodal or Multimodal Transportation Systems

- As the national transportation system becomes increasingly integrated and multimodal, modeling the environmental impact of the transportation system will require a model that equally integrates across modes of transport
- This area of research could be jointly pursued by FAA, EPA, and/or other agencies within DOT

Develop and Implement Improvements General to All Models

- A common thread among the emissions-related research proposals is updating and integrating model capabilities and outputs to reflect the most recent environmental concerns and information. This applies also for already existing models, which should also reflect and utilize the best data currently available

Noise Breakout Group

The Noise Breakout Group concentrated on issues related to aircraft noise. The group was tasked with reviewing the materials from the ER2000 Findings Report and suggesting additional areas of concern for potential research. To this end, the group worked through each issue, to develop recommendations for research projects to better measure the impact of aviation-related noise on people and the environment or to mitigate the impact on people of aircraft noise.

Aviation-related Noise Research Avenues/Areas Identified

Each of the items listed below describes an area for potential research related to the environmental impacts of aircraft and aviation-related noise. Each item represents an avenue for beneficial future research activity which the Noise Breakout Group believes should be considered as part of AEE's proposal for RE&D funding for FY2001 and beyond.

Examine the Adequacy of Current Noise Metrics and the Development of New Noise Metrics

- A common thread of the research concerns raised by some stakeholders is a possible disconnect between measurements of sound and noise levels and human perception of and annoyance by these noise levels
- Areas of concern include: Is DNL an appropriate measure of noise? Is 65 dB an appropriate DNL cutoff?
- It was agreed that the decibel level used, be it 65 dB, 55 dB, or some other level, is a policy issue which research may inform, and not a research issue *per se.*

Examine the Impact of Noise and Changes in Noise on Humans

- This area of research addresses the relationship between human health and noise, including sleep and sleep deprivation effects, differing impacts of noise in different communities and settings (e.g., urban/rural), and other human impacts

Modeling Issues: INM Data Gaps, Helicopters, General Aviation

- This area of research takes in all considerations related to the modeling of aviation-related noise, including the effects of increased activity in the future, gaps that may exist between noise modeling and actual noise measurement at airports, the adequacy of hush kits for Stage 3 compliance, and the treatment of noise generated by unique or novel aircraft types, including helicopters and the new generation of general aviation business jets

Aircraft Issues: How Noise is Produced

- This area of research includes changes in the populations affected by aircraft noise under alternative operating and fleet mix scenarios and the impact of increased cargo operations using alternate fleet mixes

Other Research Issues (flight procedures, system efficiency, updated property value impacts, and effects of noise-related vibration)

- This area of research includes issues that do not fall within the other categories, but do represent significant areas of concern, including the potential for reductions in airport noise footprints due to improved procedures and aviation system efficiency and an update of past research on hedonic valuation models connecting property values to aviation-related noise

In addition, the Noise Breakout Group considered other issues which were not felt to be research issues but which should be "forwarded" to other FAA offices as policy or legal issues. These include

- Policy issues related to poor coordination and funding of Federal and local noise mitigation activities
- Legal issues related to the increase use of local funding (PFCs) and its impact on airport incentives to meet national noise objectives
- Policy issues related to the timing and determination of noise compliance violations.

Breakout Group for Other Airport/Facility Issues

This Breakout Group concentrated on environmental issues related to aviation activity around airports but unrelated to aircraft noise or aviation-related emissions. The group was tasked with reviewing the materials from the ER2000 Findings Report and suggesting additional areas of concern for potential research. To this end, the group worked through each issue, to develop recommendations for research projects to better

measure the impact of environmental issues arising from aviation activity but unrelated to noise or emission concerns.

Research Avenues/Areas Identified

The item listed below describes an area for potential research related to the environmental impacts of aviation activity. It represents an avenue for beneficial future research activity which the Breakout Group believes should be considered as part of AEE's proposal for RE&D funding for FY2001 and beyond.

Exploratory/Preliminary Research into Existing and Potential Deicing and Anti-icing Techniques and Materials

- This area of research is intended to gather available information on the use of glycol-based substances during icing conditions at airports. It is believed that a large but unorganized body of information, located at various Federal agencies and private sector organizations, exists for these substances. Locating and organizing this information is a necessary first step before other research venues could be identified in this area. This literature search could also catalog information on deicing and anti-icing techniques and substances used at different airports domestically and internationally.
- This area of research, which could be jointly initiated and pursued by FAA and EPA, could be accomplished at relatively low cost and could provide a necessary foundation of organized and up to date information on an issue that may grow in importance

The group also discussed research addressing the environmental impacts of ground transportation to and from airports, but this issue was also discussed (and identified as an avenue for future research) by the Emissions Breakout Group. Issues related to fuel and chemical storage and recovery were discussed, and the group believed that these concerns fell within EPA jurisdiction, and in any case were being handled well by airports, especially fuel and chemical storage. The group also discussed the availability of alternate energy sources for use on the airport tarmac. It was agreed that while impacts on local air quality around airports could be affected, the connection of this effect to AEE-sponsored R&D possibilities was not as clear as with the deice/anti-ice issue.

Finally, the Emissions Breakout Group passed the issue of fuel dumping to this group. For this issue, there is a tradeoff between safety issues (which motivate the fuel dumping) and environmental impact issues (which result from the dumping). The group believed there was no clear-cut environmental R&D proposal implied by the fuel dumping issue. Nevertheless, it was observed that it may be valuable to analyze recent data on fuel dumping incidents, both to verify that it is not an action done casually by pilots, and to quantify the actual human impacts of fuel dumping that does occur.

❖ **Prioritizing among Research Opportunities: Results from a Exercise in Allocating Research Funds**

At the conclusion of the Workshop, an exercise was conducted to gauge the group's preferences among the research opportunities identified for AEE during the Workshop. There were 14 participants remaining during the final hour of the Workshop, and each of these persons was asked to allocate an imaginary $100 in "research funds" among the 18 research avenues listed above. Table 1 below displays the result of this group allocation of funds among projects.

The three numerical columns of the table show the average allocation by participants to a particular area of environmental research, the group total allocation, and the proportionate allocation to each area if the allocation were made from a hypothetical R&D budget of $2 million. Among those who "voted" in this exercise, noise-related research areas received the majority (52 per cent) of funds, while emissions-related research areas received about 45 percent of funds. The balance (three percent) was allocated to the proposed exploratory research on deicing and anti-icing techniques and materials.

Table 1. Results from *ER2000* Findings Workshop Research Funds Allocation Exercise

AREA OF PROPOSED AVIATION RELATED ENVIRONMENTAL RESEARCH	Group Allocation of "Research Funds"		
❖ EDMS model enhancements needed	$ 9.29	$ 130	$ 185,714
❖ Improve environmental impact measurement for altitude < 3,000 ft.	$ 7.86	$ 110	$ 157,143
❖ Improve emissions implied by growth models and metrics	$ 5.64	$ 79	$ 112,857
❖ Develop tools to examine noise emissions trade-off	$ 5.57	$ 78	$ 111,429
❖ Understand impact of airline service and how it affects environment etc.	$ 2.36	$ 33	$ 47,143
❖ Technical research on impact of particulates	$ 3.07	$ 43	$ 61,429
❖ Measure emissions from ground Access to airport	$ 2.29	$ 32	$ 45,714
❖ High altitude emissions models	$ 2.29	$ 32	$ 45,714
❖ Develop multiple airport regional Emissions models	$ 1.93	$ 27	$ 38,571
❖ Exploratory study, environmental Impact on space	$ 1.86	$ 26	$ 37,143
❖ Develop intermodal models / metrics	$ 1.43	$ 20	$ 28,571
❖ Improvements general to all models	$ 1.00	$ 14	$ 20,000
EMISSIONS-RELATED RESEARCH AREAS	**$ 44.57**	**$ 624**	**$ 891,429**
❖ Adequacy of current metrics and develop new metrics	$ 17.43	$ 244	$ 348,571
❖ Impact of noise and changes in noise on humans	$ 16.07	$ 225	$ 321,429
❖ Modeling-INM data gaps, Helicopters, GA	$ 9.21	$ 129	$ 184,286
❖ Aircraft issues: How noise is produced	$ 5.79	$ 81	$ 115,714
❖ Other research issues	$ 3.71	$ 52	$ 74,286
NOISE-RELATED RESEARCH AREAS	**$ 52.21**	**$ 731**	**$ 1,044,286**
❖ Deicing and anti-icing Information Base	$ 3.21	$ 45	$ 64,286
OTHER AIRPORT/FACILITY ISSUES	**$ 3.21**	**$ 45**	**$ 64,286**
TOTAL "RESEARCH BUDGET"	**$ 100.00**	**$ 1,400**	**$ 2,000,000**
	(avg)	**(total)**	**(as part of $2M Budget)**